

SUISSE  
FRANCE

LHCb

ATLAS

CERN Meyrin

CERN Prévessin

SPS 7 km

CMS

CERN

ALICE

LHC 27 km

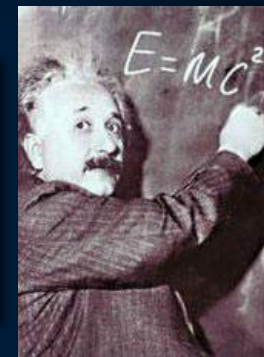
***Accelerating Science and Innovation***



# The Mission of CERN

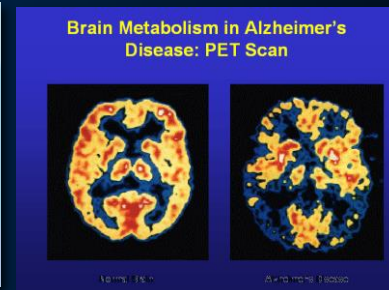
## ❑ Push back the frontiers of knowledge

E.g. the secrets of the Big Bang ...what was the matter like within the first moments of the Universe's existence?

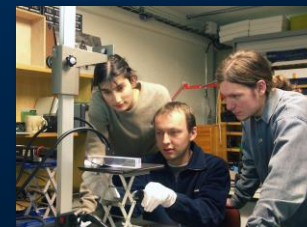


## ❑ Develop new technologies for accelerators and detectors

Information technology - the Web and the GRID  
Medicine - diagnosis and therapy



## ❑ Train scientists and engineers of tomorrow



## ❑ Unite people from different countries and cultures



# CERN: founded in 1954: 12 European States

“Science for Peace”

## Today: 22 Member States

~ 2300 staff

~ 1600 other paid personnel

~ 12700 scientific users

Budget (2016) ~1000 MCHF

**Member States:** Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Slovak Republic, Spain, Sweden, Switzerland and United Kingdom

**Associate Member States in accession to Membership:** Cyprus, Serbia

**Associate Member States:** Pakistan, Turkey

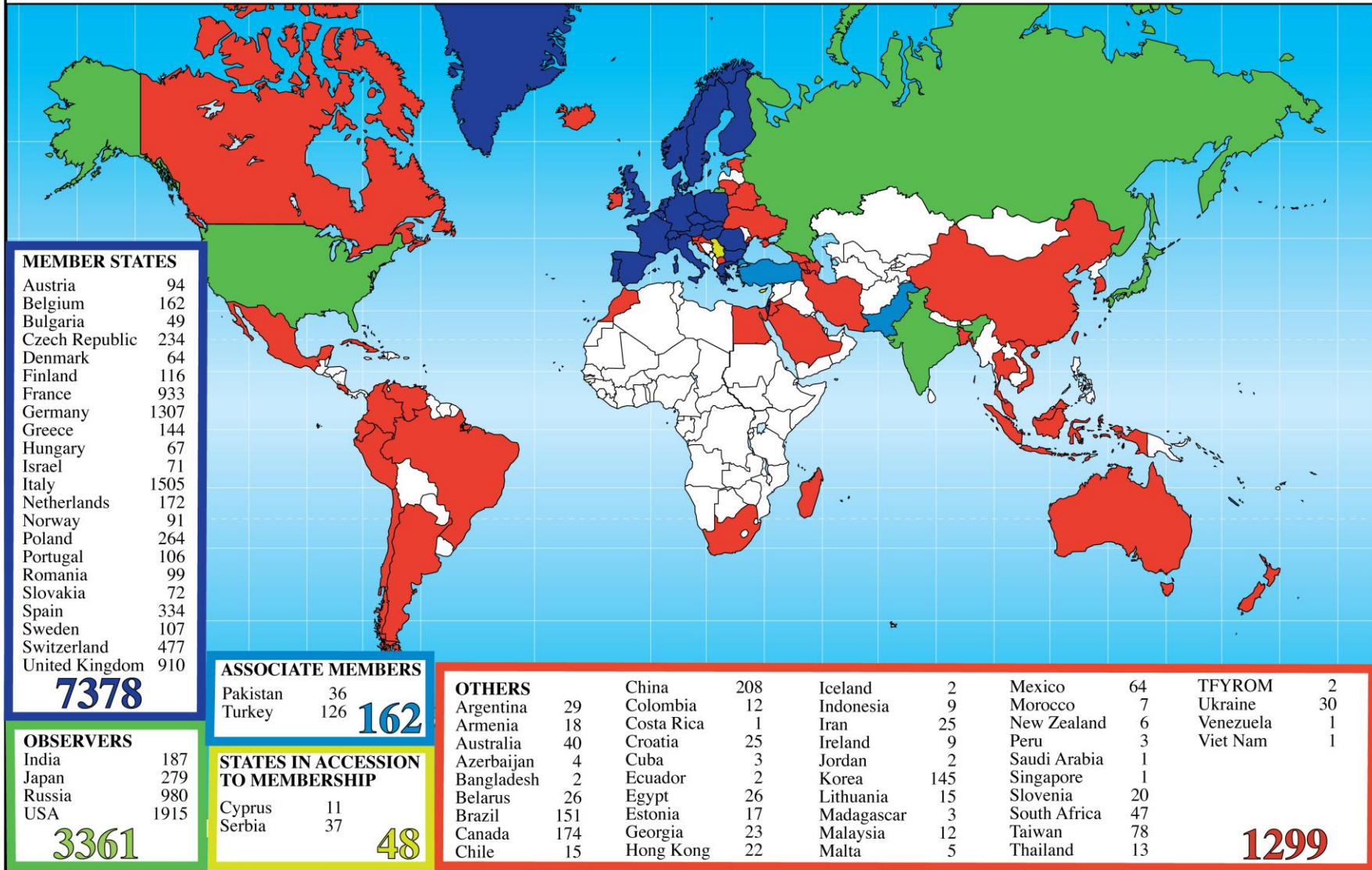
**Applications for Membership or Associate Membership:**

Brazil, Croatia, India, Lithuania, Russia, Slovenia, Ukraine

**Observers to Council:** India, Japan, Russia, United States of America; European Union, JINR and UNESCO

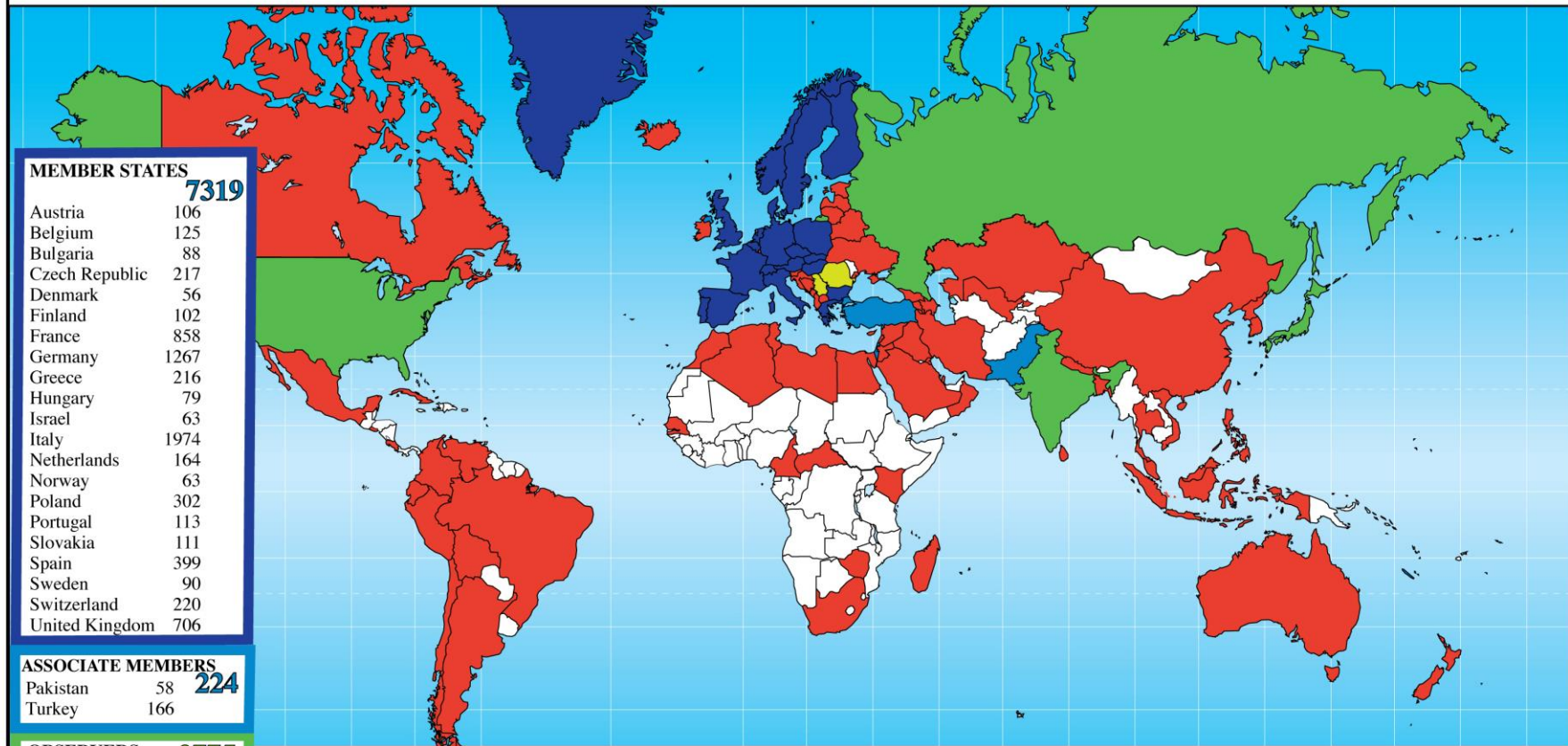
# Science is getting more and more global

## Distribution of All CERN Users by Location of Institute on 12 January 2016



# Science is getting more and more global

## Distribution of All CERN Users by Nationality on 12 January 2016



### MEMBER STATES **7319**

Austria	106
Belgium	125
Bulgaria	88
Czech Republic	217
Denmark	56
Finland	102
France	858
Germany	1267
Greece	216
Hungary	79
Israel	63
Italy	1974
Netherlands	164
Norway	63
Poland	302
Portugal	113
Slovakia	111
Spain	399
Sweden	90
Switzerland	220
United Kingdom	706

### ASSOCIATE MEMBERS **224**

Pakistan	58
Turkey	166

### OBSERVERS **2775**

India	284
Japan	316
Russia	1071
USA	1104

### STATES IN ACCESSION TO MEMBERSHIP **176**

Romania	131
Serbia	45

### OTHERS

Bosnia & Herzegovina	1	Cyprus	19	Jordan	8	Malaysia	18	Philippines	4	Taiwan	56
Brazil	135	Ecuador	4	Kazakhstan	1	Malta	5	Qatar	1	Thailand	20
Canada	154	Egypt	24	Kenya	2	Mauritius	1	San Marino	1	T.F.Y.R.O.M.	2
Cameroon	2	El Salvador	1	Korea, D.P.R.	4	Mexico	84	Saudi Arabia	1	Tunisia	3
Albania	12	Estonia	15	Korea Rep.	151	Montenegro	2	Senegal	1	Ukraine	88
Argentina	8	Georgia	44	Latvia	1	Morocco	13	Singapore	3	Uzbekistan	5
Central African Rep.	1	Iceland	4	Lebanon	12	Nepal	7	Sint Maarten	1	Venezuela	11
Armenia	27	Indonesia	10	Libya	1	New Zealand	6	Slovenia	27	Viet Nam	8
Australia	31	Iran	54	Lithuania	30	Oman	1	South Africa	31	Zimbabwe	5
Azerbaijan	11	Croatia	38	Iraq	1	Palestine (O.T.)	7	Sri Lanka	3		
Bangladesh	7	Cuba	13	Ireland	20	Madagascar	4	Syria	1		
Belarus	50										
Bolivia	2										

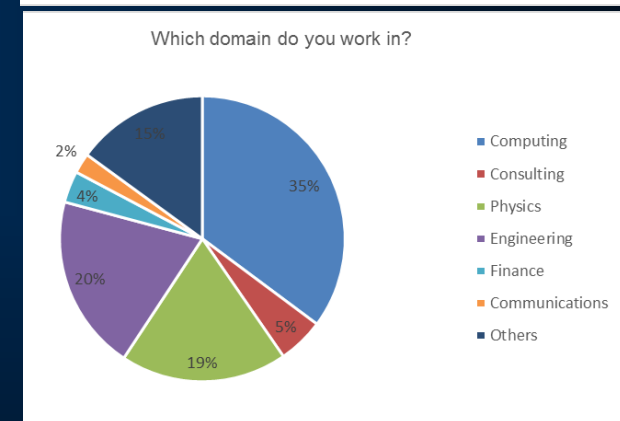
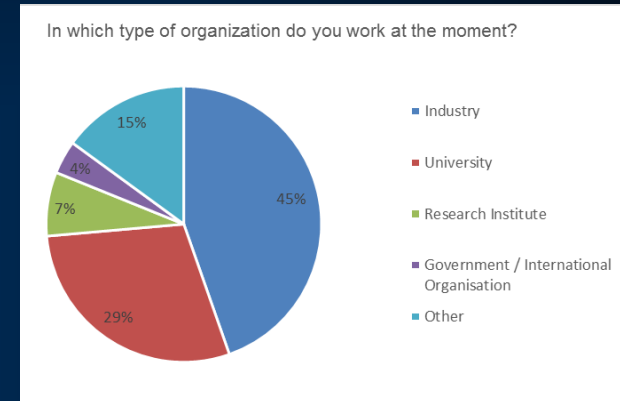
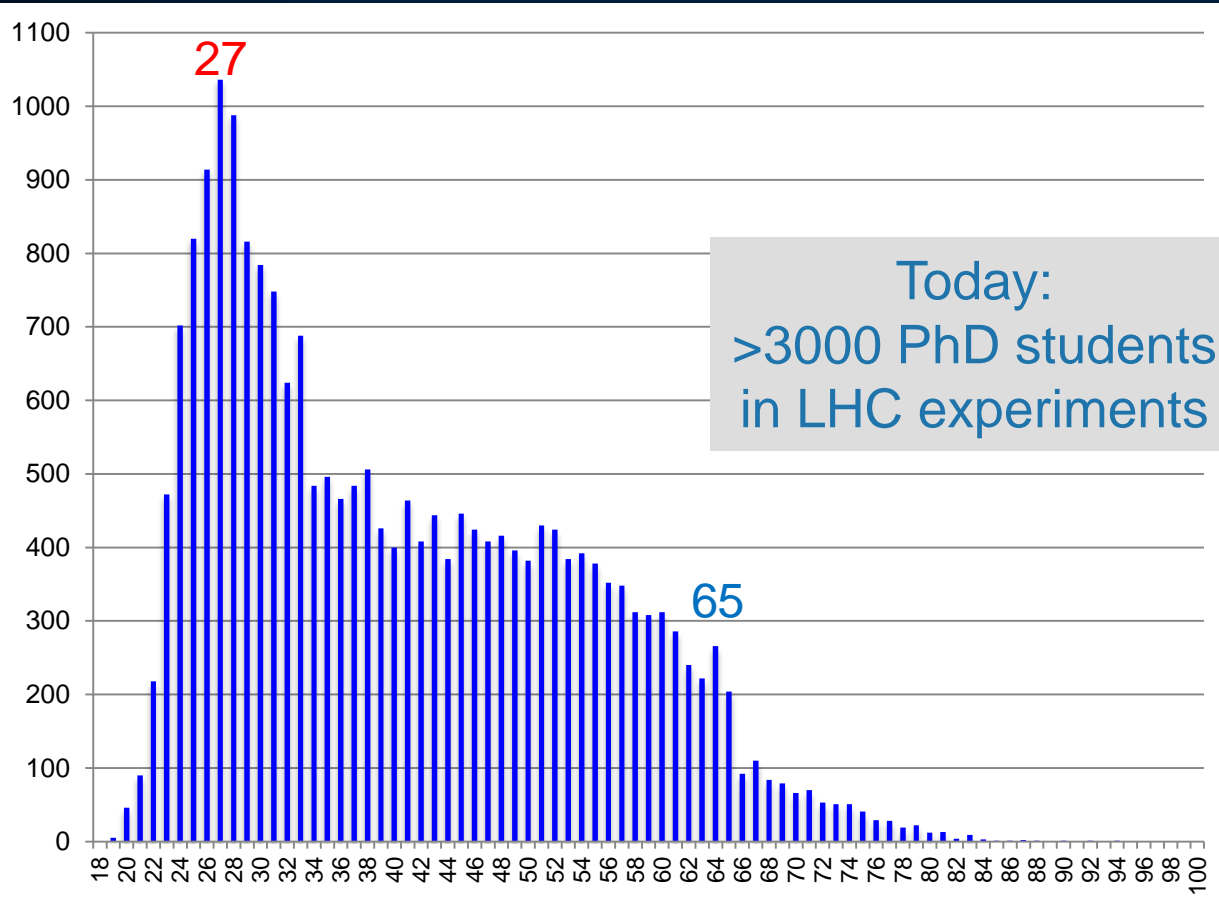
**1822**





# Age Distribution of Scientists

- and where they go afterwards

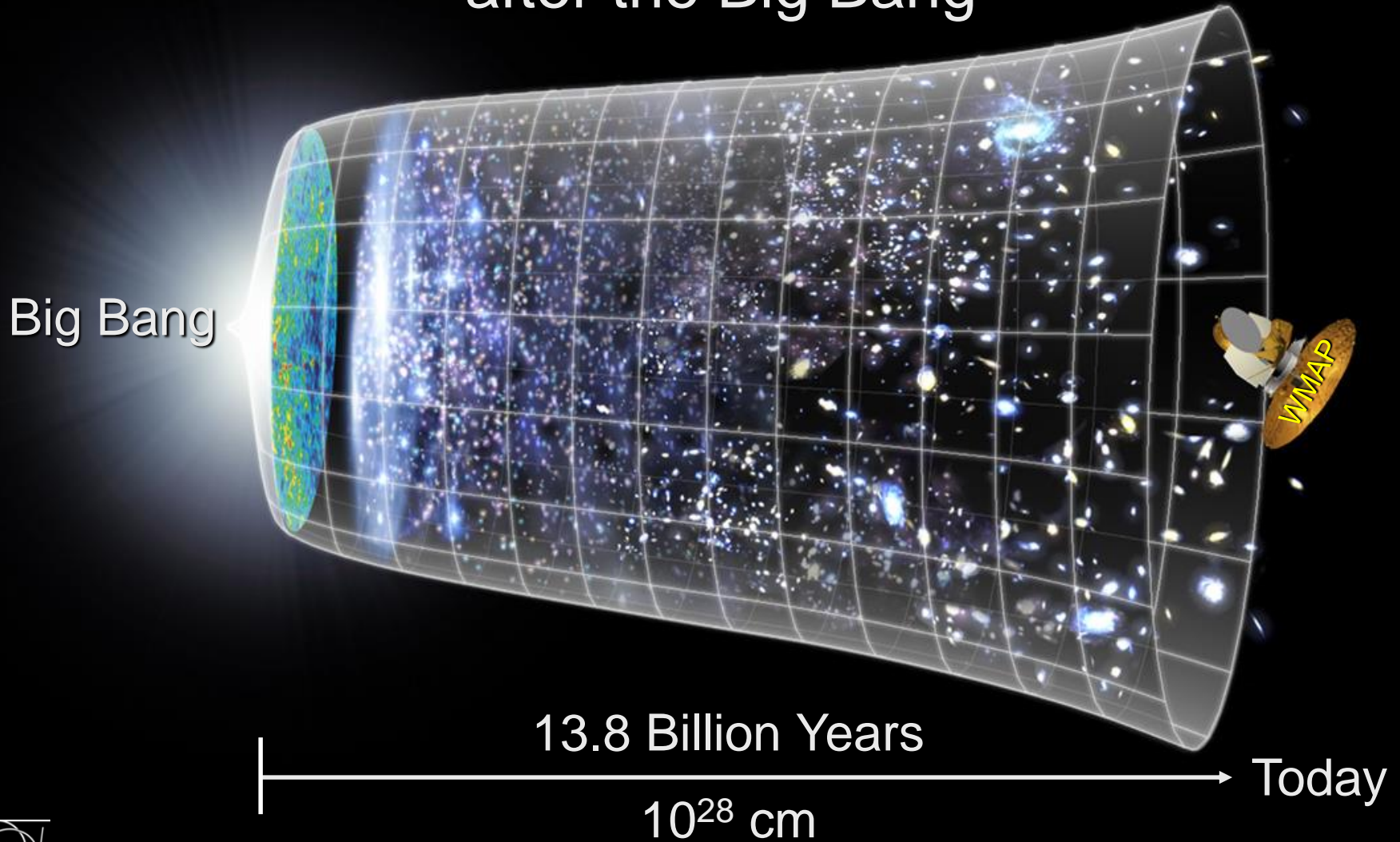


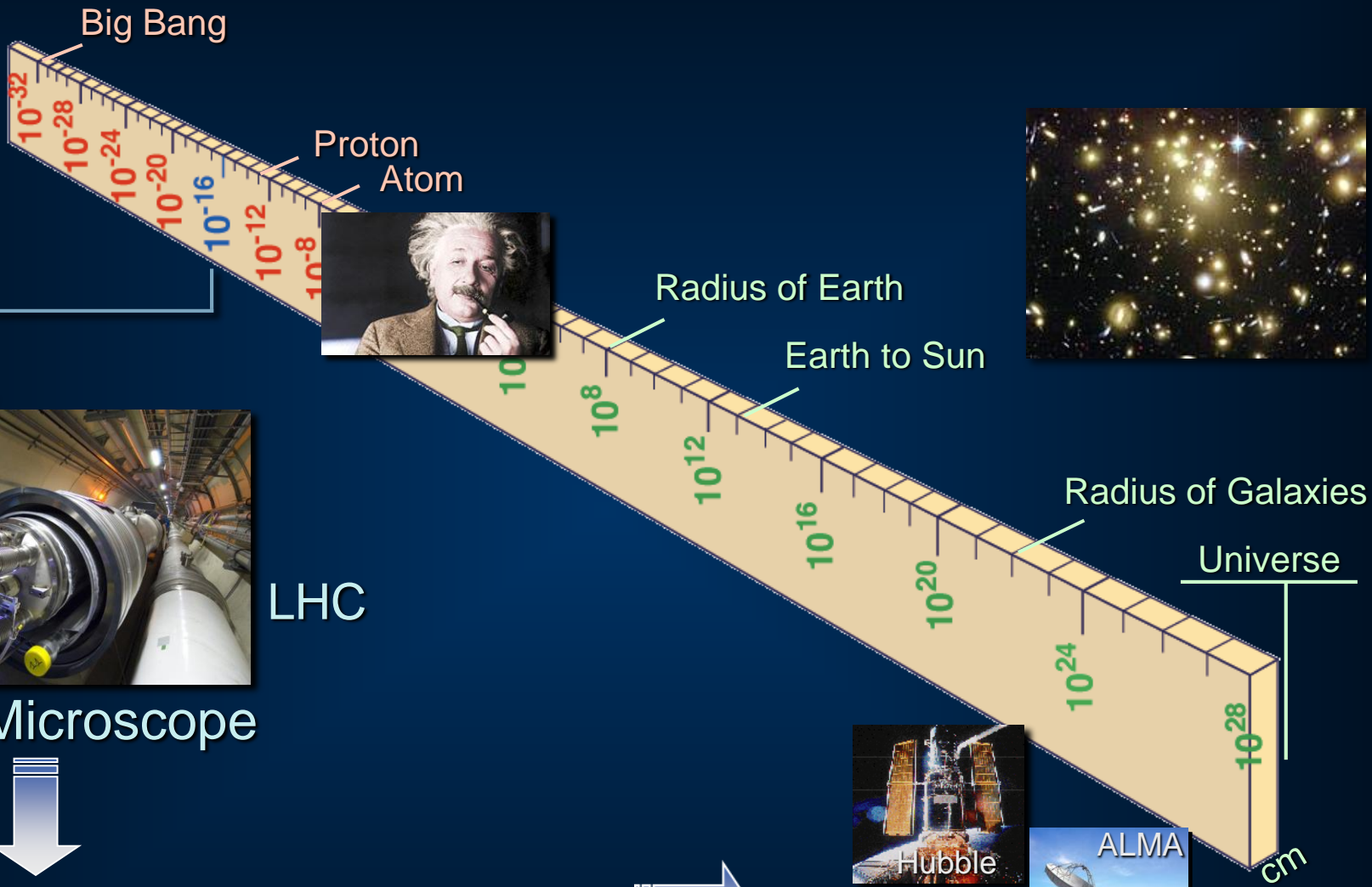
They do not all stay: where do they go?



# Next Scientific Challenge:

to understand the very first moments of our Universe  
after the Big Bang





LHC

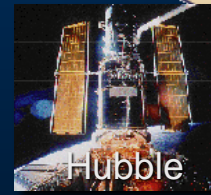
Super-Microscope



Reproducing conditions

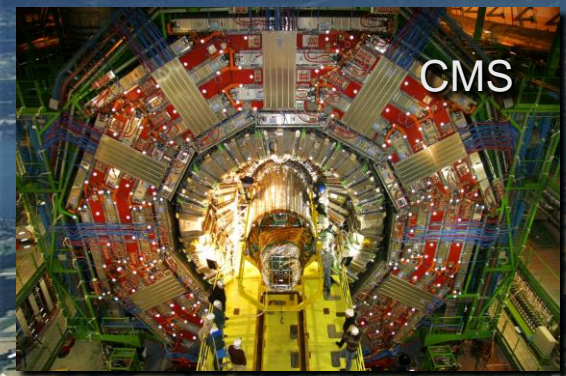


Looking back





# 2010: a New Era in Fundamental Science



Exploration of a new energy frontier  
in p-p and Pb-Pb collisions



# Discovery 2012, Nobel Prize in Physics 2013



The Nobel Prize in Physics 2013 was awarded jointly to François Englert and Peter W. Higgs *"for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider"*.



# CERN: Particle Physics and Innovation

- **Interfacing** between fundamental science and key technological developments



- **CERN Technologies and Innovation**



Accelerating particle beams



Detecting particles



Large-scale computing (Grid)

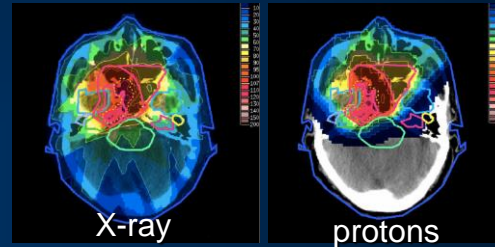
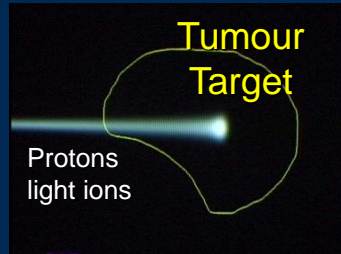
# Medical Application as an Example of Particle Physics Spin-off

Combining Physics, ICT, Biology and Medicine to fight cancer



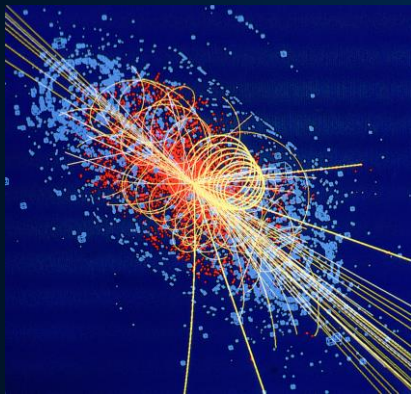
## Hadron Therapy

Accelerating particle beams  
~30'000 accelerators worldwide  
~17'000 used for medicine



Leadership in Ion Beam Therapy now in Europe and Japan

>100'000 patients treated worldwide (45 facilities)  
>50'000 patients treated in Europe (14 facilities)

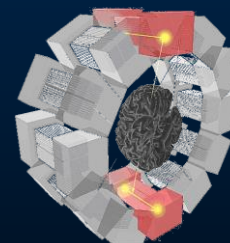


## Imaging

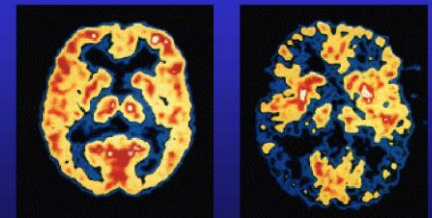
Clinical trial in Portugal, France and Italy for new breast imaging system (ClearPEM)



## PET Scanner



Brain Metabolism in Alzheimer's Disease: PET Scan



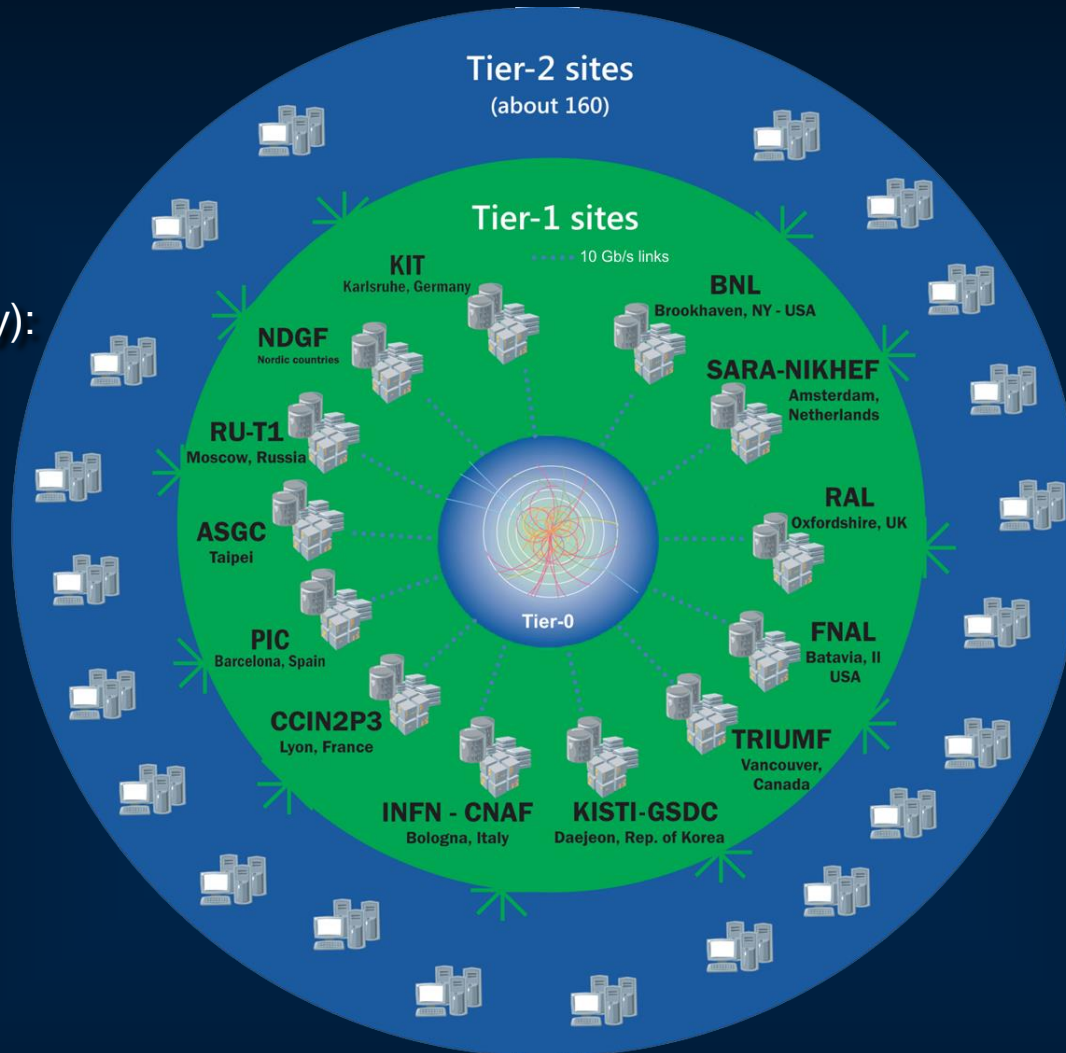
Detecting particles

# The Worldwide LHC Computing Grid

Tier-0  
(CERN and Hungary):  
data recording,  
reconstruction and  
distribution

Tier-1: permanent  
storage, re-  
processing,  
analysis

Tier-2: Simulation,  
end-user analysis



~170 sites,  
40 countries

~500k CPU cores

500 PB of storage

> 2 million jobs/day

10-100 Gb links

## WLCG:

An International collaboration to distribute and analyse LHC data

Integrates computer centres worldwide that provide computing and storage resource into a single infrastructure accessible by all LHC physicists



# CERN Education Activities

## Scientists at CERN

Academic Training Programme



## Young Researchers

CERN School of High Energy Physics  
CERN School of Computing  
CERN Accelerator School



CERN School of Physics  
Norway, June 2016

## Physics Students

Summer Students  
Programme



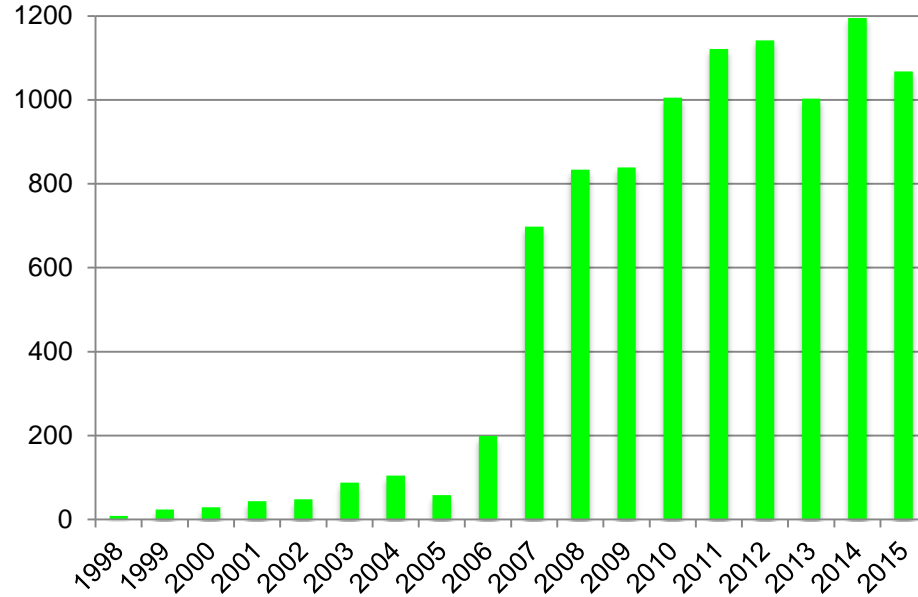
## CERN Teacher Schools

International and National  
Programmes



# CERN Teacher Programme

## Teacher Programme Participants 1998 - 2015 (Total: 9509)



MEMBER STATES	
Austria	177
Belgium	123
Bulgaria	455
Czech Republic	154
Denmark	199
Finland	498
France	314
Germany	902
Greece	671
Hungary	446
Israel	47
Italy	551
Netherlands	143
Norway	106
Poland	580
Portugal	386
Slovakia	222
Spain	441
Sweden	216
Switzerland	124
United Kingdom	1161

ASSOCIATE MEMBERS	
Pakistan	2
Turkey	161
<b>Total</b>	<b>163</b>

OBSERVERS	
India	4
Japan	7
Russia	336
USA	97
<b>Total</b>	<b>444</b>

CANDIDATES FOR ACCESSION	
Romania	14
Serbia	68
<b>Total</b>	<b>82</b>

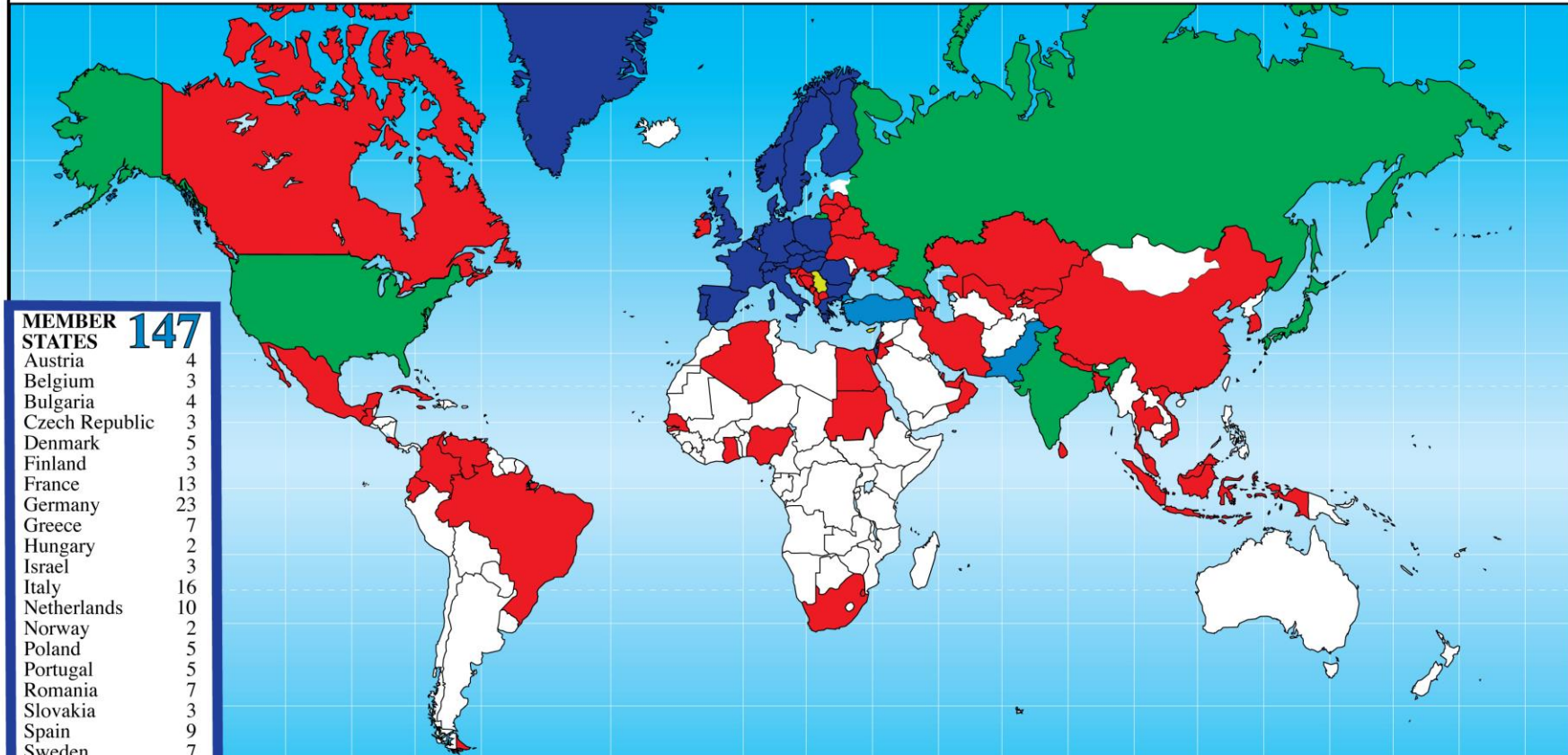
OTHERS	
Angola	7
Armenia	1
Australia	6
Azerbaijan	1
Bahrain	2
Belarus	3
Brazil	167
Burundi	2
Cameroon	4
Canada	8
Cape Verde	4
Chile	3
China	2
Costa Rica	4
Croatia	1
Cyprus	10
Dominican Rep.	45
Ecuador	2
Egypt	2
Estonia	66
Georgia	104
Ghana	6
Guinea Bissau	1
Iran	6
Ireland	8
Jordan	11
Kazakhstan	8
Kenya	4
Latvia	1
Lebanon	1
Lithuania	32
Madagascar	2
Malta	36
Mexico	14
Mongolia	1
Montenegro	14
Morocco	2
Mozambique	21
Nepal	2
New Zealand	2
Palestine (O.T.)	4
Qatar	1
Rwanda	20
Sao Tome	6
Saudi Arabia	1
Singapore	2
Slovenia	21
South Africa	7
South Korea	48
Swaziland	1
Taiwan	1
Thailand	12
T.F.Y.R.O.M.	12
Timor-Leste	9
Uganda	3
Ukraine	117
U.A.E.	1
<b>Total</b>	<b>904</b>



# Summer Students 2016



## Summer Students 2016



### MEMBER STATES 147

Austria	4
Belgium	3
Bulgaria	4
Czech Republic	3
Denmark	5
Finland	3
France	13
Germany	23
Greece	7
Hungary	2
Israel	3
Italy	16
Netherlands	10
Norway	2
Poland	5
Portugal	5
Romania	7
Slovakia	3
Spain	9
Sweden	7
Switzerland	3
United Kingdom	12

### OBSERVERS 49

India	16
Japan	5
Russia	9
USA	19

### ASSOCIATE MEMBERS 7

Pakistan	4
Turkey	3

### STATES IN ACCESSION FOR MEMBERSHIP 7

Cyprus	2
Serbia	5

### OTHERS

Albania	1	Colombia	1	Iran	2	Madagascar	1	Singapore	1	Venezuela	1
Algeria	2	Costa Rica	3	Ireland	1	Malaysia	3	Slovenia	1	Viet Nam	1
Azerbaijan	2	Croatia	2	Jamaica	1	Malta	4	South Africa	2		
Bangladesh	1	Cuba	1	Jordan	2	Mexico	1	Sri Lanka	1		
Belarus	1	Ecuador	1	Kazakhstan	1	Montenegro	2	Sudan	1		
Bosnia	2	Egypt	4	Korea	1	Nepal	1	Thailand	3		
Brazil	1	Georgia	1	Kyrgyzstan	1	Nigeria	2	T.F.Y.R.O.M.	3		
Canada	5	Ghana	1	Latvia	1	Oman	1	U.A.E.	1		
China	11	Guatemala	1	Lebanon	2	Palestine	2	Ukraine	3		
		Indonesia	3	Lithuania	1	Qatar	1	Uzbekistan	1		





Thank You!



*Accelerating Science and Innovation*